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(54) ROTARY PERCUSSIVE APPARATUS

(71) We, ROBERT BOSCH GMBH, a German company of Postfach 50, 7000 Stuttgart 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention concerns a rotary percussion apparatus, having at least one substantially radially moveable locking member of a tool holder, which, engaging in one or more recesses of a tool shank limits the ability of the tool to move axially relative to the tool holder.

Two grooves of semi-circular cross-section closed at both ends in an axial direction are arranged diametrically opposite one another in the tool shank of one known rotary percussive drill. The ends of the grooves are made concave hemispherical. Spherically locking members which are radially moveably guided in a tool holder engage in the grooves. In this manner, the locking members transmit a rotary motion from the tool holder to the tool. The ends of the grooves serves as axial abutments which limit the ability of the tool to move axially in the tool holder. With this known apparatus, there is a disadvantage that the spherical locking members are not only installed for torque transmission but also serve for the axial locking of the drill in the tool receiver. The considerable loads which thus occur lead, in arduous construction work, to the comparatively rapid wear of the locking members and also of the grooves in the tool shank. In an attempt to overcome this disadvantage locking members having a cylindrical form have already been used instead of spherical locking members. However, it has been shown that the same disadvantages also attach to these known locking members even though they apparently occur somewhat less severely.

Thus, it is an object of the invention to provide a compactly constructed rotary percussive apparatus which achieves a high tool life.

According to the present invention there is provided a rotary percussive apparatus comprising a rotary percussive driver having a tool holder, and a tool received by the tool holder, axial movement of the tool relative to the tool holder being limited by the engagement of at least one locking member provided on the tool holder with one or more recesses in the tool shank, the locking member being movable substantially radially outwardly to permit removal of the tool from the tool holder, wherein in addition to the or each said recess at least one rotary drive receiving groove is provided in the tool shank, the or each drive receiving groove having a substantially radially extending flank which co-operates with an associated drive surface of an elongate driving member of the tool holder for transferring rotary drive from the tool holder to the tool.

An embodiment of the invention has the advantage that the two functions: axial locking and rotary driving are separate from one another. Thus, each of the two parts of the apparatus associated with the two aforesaid functions, can be formed in the most favourable manner. The driving member can be fixedly arranged in the tool holder. The surfaces serving for torque transmisstion, can be arranged extending substantially radially, whereby the torque to be transmitted from the tool holder to the tool shank is effected as forces which are substantially perpendicular to the transmission surfaces. This involves a very considerable reduction in wear. The or each recess in the tool shaft must then only undertake the function of axial locking. A particularly short construction of tool shank is produced when the or each drive receiving groove extends over the same axial region of the tool shank in which the or each recess is formed. It has proved to be very suitable for the radial depth of the drive receiving groove to be between 0.15 *d* and 0.25 *d*, preferably 0.2 *d*, wherein *d* is the diameter of the tool shank.

Further advantageous developments of the subject matter of the invention will become apparent from the following description of a preferred embodiment thereof, reference being had to the accompanying drawings, wherein:

Figure 1 shows a tool holder with an inserted tool in longitudinal section, in an enlarged representation, of a hammer drill;

Figure 2 a cross-section along II—II in Figure 1;

Figure 3 a second embodiment of a tool shank,

Figure 4 a cross-section along IV—IV in Figure 3;

Figure 5 a third embodiment of a tool shank,

Figure 6 is a cross-section along VI—VI in Figure 5,

Figure 7 a fourth embodiment of a tool shaft,

Figure 8 a cross-section VIII—VIII in Figure 7,

Figure 9 a section through a drive receiving groove as a detail greatly increased in size,

Figure 10 a cross-section through a further embodiment of a drive receiving groove according to Figure 9,

Figure 11 a cross-section through a fifth embodiment of a tool shaft.

Referring to Figure 1, a tool spindle 2 extends from the end of the housing of a hammer drill 1, only part of which is illustrated. The tool spindle 2 transmits torque and axial blows on a tool holder 3 rigidly connected to it. The shank 5 of a drill 6 is pushed into a receiving bore 4 of the tool holder 3. Two recesses 7 closed at both ends in an axial direction are formed on the tool shank 5 opposite one another on a first diameter, in which recesses engage locking balls 8. As can be seen from Figure 2, the flute or groovelike recessed 7 have a part circular cross-sectional shape. The locking balls 8 may move out of the recesses 7 in the tool shank 5 on axial displacement of a sleeve 12, so that the drill 6 can be withdrawn from the tool holder 3. In addition to the recesses 7, a drive receiving grooves 9 open at the end of the tool shank 5 are formed on the tool shank 5 lying opposite one another on a second diameter. As can be seen from Figure 2, the drive receiving grooves 9 are angularly displaced by 90° with respect to the recesses 7. The drive receiving grooves 9 have two substantially radially extending flanks 10 which are preferably planar and which co-operate with associated surfaces on driving members 11 which are arranged on the cylindrical inner wall of the receiving bore 4 of the tool receiver 3. The radial depth t of the drive receiving groove 9 can amount to 0.15 to 0.25 of the diameter d of the tool shank 5. Optimum results are obtained when d=10 mm with t=0.2 d, i.e. 2 mm.

The end of the tool shank 5 engages a dolly extension of the tool spindle 2 of the hammer drill, transmitting the axial blows. The forward portion of the drill 6 lying in front of the tool shank 5 is made in the usual manner so that an illustration has been omitted from the drawing. A portion of the drill 6 including a delivery helix for carrying away the debris broken loose by a drill head is connected to the drill head which is provided with hard metal cutting edges.

On rotation of the tool spindle 2, the torque is transmitted to the tool shank 5 of the drill 6 through the driving members 11 engaging the drive receiving grooves 9. Very favourable conditions are produced by the substantially radially extending flanks 10 and the associated surfaces of the driving members 11, since the forces to be transmitted are substantially perpendicular to the co-operating surfaces. Even after considerable wear, the force transmission still takes place at surfaces rather than at the edges of the recesses as with the known drills referred to above. The recesses 7 in the tool shank 5 simply serve for the axial locking of the drill in the tool holder 3. Hereby, the load on the locking balls 8 thus also their wear, is very considerably reduced with respect to the known apparatus for torque transmission.

A second embodiment of the tool shank 15 is shown in Figures 3 and 4 of the drawing. This tool shank is especially suitable for a smaller diameter d less than 10 mm. Once again, a recess 7 is formed in the tool shank, which fully corresponds to the recess of the first embodiment (Figures 1, 2). Lying opposite on one diameter, a drive receiving groove 19 is arranged the front end of which is closed and the rear end of which is open as in the case of the grooves 9 of the first embodiment. As may be appreciated from the cross-section of Figure 4, the drive receiving groove 19 is formed with substantially radially extending plane flanks 20. Moreover, in this embodiment, chamfers 21 are provided at the transition of the flanks 20 of the grooves and the cylindrical outer surface of the tool shank 15 The chamfers 21 can be made concave with the same radius of curvature as that of the recesses 7 as illustrated in Figure 4 or can be made with plane surfaces as illustrated in Figure 9. The depth t of the drive receiving groove 19 is preferably 0.2 d as in the first embodiment. A ball as in the first embodiment or a cylindrical roller with hemispherical ends can be used as a locking member. The drive members in the tool holder, which engage in the drive receiving groove 19, have a cross-section fitting the cross-section of the groove. The advantage of the arrangement of chamfers 21 lies in a greater immunity against external damage to the tool shank and also in a reduced readiness to burring at the transition of the flanks 20 and the cylindrical outer surface of the tool shank 15.

The embodiment of a tool shank 25 shown in Figures 5 and 6 is distinguished from the embodiment according to Figure 1 and Figure 2 by the fact that two opposite recesses 27 which each have a semicircular cross-section, are arranged on a first diameter and extend transverse to the axis of the tool shank 25. These recesses too are closed at both ends viewed in an axial direction of the tool shank 25; but are of course open viewed transversely with respect to the axis. The recesses 27 are suitable for a tool receiver having cylindrical or prismatic locking members, the longitudinal axes of which are transverse to the tool axis. Furthermore, two drive receiving grooves 9 which fully correspond to the drive receiving grooves 9 of the first embodiment, are arranged on a second diameter spaced 90° from the first diameter. The drive receiving grooves can of course also be produced corresponding to the drive receiving groove 19 of the embodiment according to Figures 3 and 4.

A fourth embodiment of the tool shank 35 is represented in Figures 7 and 8. This embodiment is also suitable for a tool holder having for example cylindrical or prismatic locking members, the longitudinal axes of which are transverse to the tool axis. In this case, the recess 37 closed at both ends viewed in an axial direction and associated with the locking members is provided as an annular groove extending around the periphery of the tool shank 35. Once again, two drive receiving grooves are arranged in an axial direction, which lie on one diameter and which are made corresponding to the drive receiving grooves 9 or the drive receiving grooves 19. In this embodiment two further drive receiving grooves can be arranged on a second diameter, for example perpendicular to the first diagonal on which the drive receiving grooves 9 are arranged. In this manner, a tool shank 35 can be provided which is suitable for very high torque stresses.

In Figure 9 there is illustrated a drive receiving groove similar to that of the embodiment of Figures 3 and 4. The difference from the second embodiment resides in the fact that in this Figure 9 case the chamfers 21 are formed as flat surface portions, whereas in the Figures 3 and 4 embodiments they are made concave. The flat chamfers 21 are easier to produce from a manufacturing point of view.

In Figure 10, a further drive receiving groove 39 is illustrated which is suitable for the transmission of the larger torques. Whereas the drive receiving groove 19 according to Figures 3, 4 and 9 includes a single key way, the drive receiving groove 39 includes two key ways adjacent to each other. Also in this case flat chamfers 41 are once again arranged at the transition of the flanks 40 and the cylindrical outer surface of the tool shank 35. The tooth-like projection 42 formed between the two keys of the drive receiving groove 39, is shortened with respect to the two outer flanks 40 so that the total width of the drive receiving groove 39 is not too large. The drive receiving groove 39 can be used with any of the previously described embodiments of the tool shank.

The cross-section of a final embodiment of a tool shank 55 is represented in Figure 11. In this embodiment, two recesses closed in an axial direction, which fully correspond to the recesses 7 of the embodiment according to Figures 1 and 2, are arranged opposite one another on a first diameter. Two drive receiving grooves 19, which can fully correspond to the drive receiving grooves 19 of the embodiment according to the Figures 3, 4 and 9, are arranged on a second diameter angularly displaced with respect to the first diameter. The second diameter on which the drive receiving grooves are arranged, is angularly displaced in a sense of rotation 56 by an angle β which in this instance amounts to 60°. The angle β can have any value within the angular range of 45° to 90°, depending on the diameter d of the tool shank 55. The advantage of the embodiment according to Figure 11 over the symmetrical arrangement of all the preceding embodiments, lies in the fact that an increased margin of wear is available at the torque transmitting flanks 57. In other words, with this embodiment, there is an increased volume of material behind the flanks 57 available to be worn away with respect to the previously described embodiments. Thus, this embodiment has an increased tool life as compared with the other embodiments.

WHAT WE CLAIM IS:—

1. A rotary percussive apparatus comprising a rotary percussive driver having a tool holder, and a tool received by the tool holder, axial movement of the tool relative to the tool holder being limited by

the engagement of at least one locking member provided on the tool holder with one or more recesses in the tool shank, the locking member being movable substantially radially outwardly to permit removal of the tool from the tool holder, wherein in addition to the or each said recess at least one rotary drive receiving groove is provided in the tool shank, the or each drive receiving groove having a substantially radially extending flank which co-operates with an associated drive surface of an elongate driving member of the tool holder for transferring rotary drive from the tool holder to the tool.

2. A rotary percussive apparatus according to claim 1 wherein the or each drive receiving groove extends over the same axial region of the tool shank as the or each recess.

3. A rotary percussive apparatus according to claim 1 or claim 2 wherein the or each recess is elongate and extends parallel to the axis of the tool shank.

4. A rotary percussive apparatus according to any of claims 1 to 3 wherein a said recess is arranged diametrically opposite the or each drive receiving groove.

5. A rotary percussive apparatus according to any of claims 1 to 3 wherein two said recesses are arranged opposite each other on a first diameter and two drive receiving grooves are arranged opposite each other on a second diameter angularly spaced from the first diameter.

6. A rotary percussive apparatus according to claim 5 wherein the second diameter, viewed in the direction of rotation of the tool shank, is spaced from the first diameter by an angle of between 45° and 90°, preferably by an angle of 60°.

7. A rotary percussive apparatus according to any preceding claim wherein the or each recess is part cylindrical.

8. A rotary percussive apparatus according to claim 1 wherein the or each recess is an annular recess extending around the periphery of the tool shank, and wherein the or each drive receiving groove extends parallel to the axis of the tool shank and intersects the or each annular recess at right angle.

9. A rotary percussive apparatus according to any preceding claim wherein the radial depth t of the or each drive receiving groove is between 0.15 d and 0.25 d and is preferably 0.2 d where d is the diameter of the tool shank.

10. A rotary percussive apparatus according to any preceding claim wherein the or each drive receiving groove includes two adjacent key ways.

11. A rotary percussive apparatus according to any preceding claim wherein chamfers, which are preferably flat, are provided at the transition of the flanks of the or each drive receiving groove and the outer surface of the tool shank.

12. A rotary percussive apparatus, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig. 2

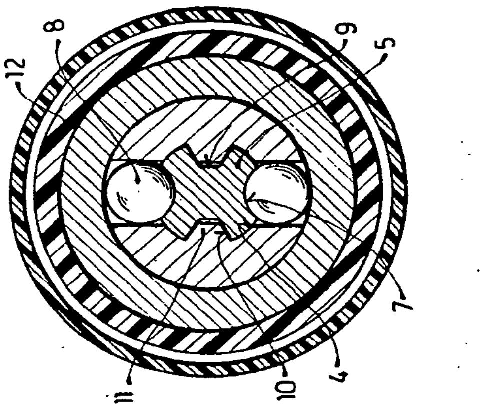
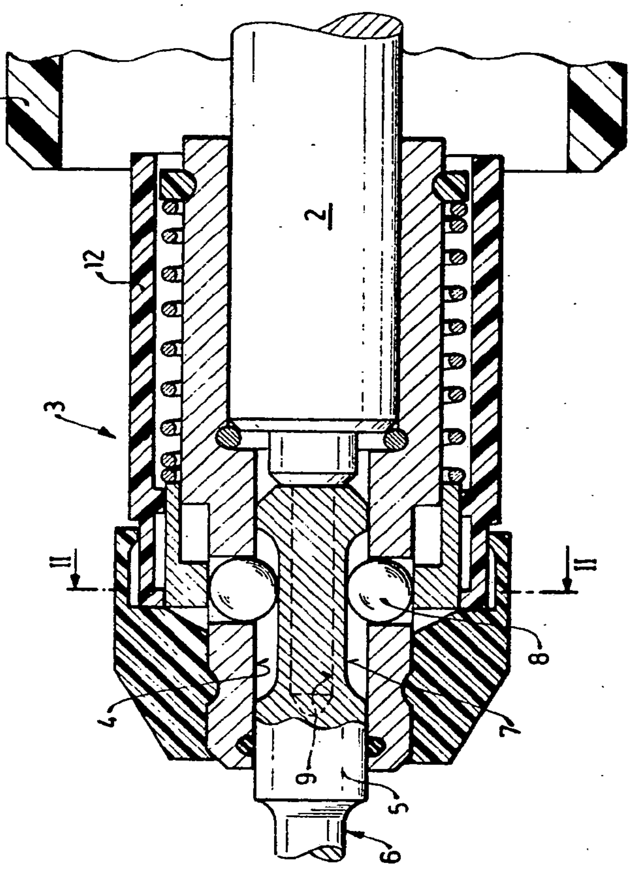


Fig. 1



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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

Fig.3

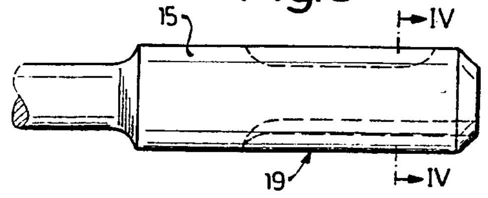

Fig.4

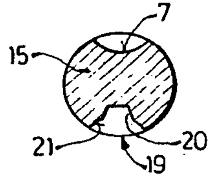

Fig.5

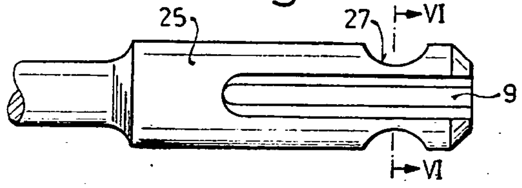

Fig.6

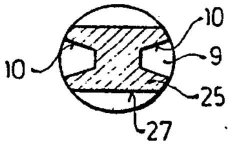

Fig.7

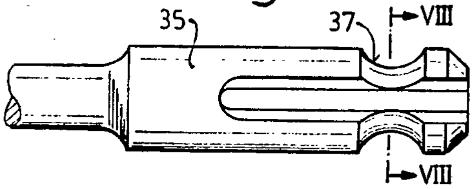

Fig.8

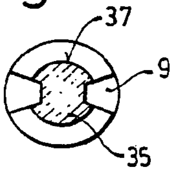

Fig.9

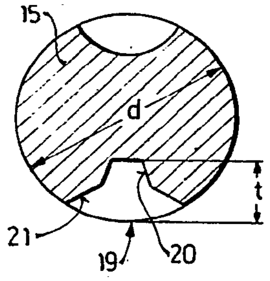

Fig.10

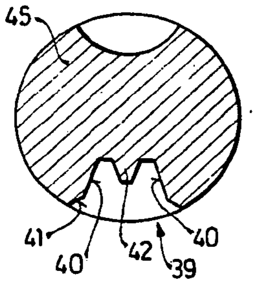

Fig.11